



Singleton, D. A., McGarry, J., Torres, J. R., Killick, D., Jewell, C., Smyth, S., Brant, B., Sánchez-Vizcaíno, F., Dawson, S., Pinchbeck, G. L., Noble, P. J. M., & Radford, A. D. (2019). Small animal disease surveillance 2019: Pruritus, pharmacosurveillance, skin tumours and flea infestations. *Veterinary Record*, 185(15), 470-475.  
<https://doi.org/10.1136/vr.l6074>

Peer reviewed version

Link to published version (if available):  
[10.1136/vr.l6074](https://doi.org/10.1136/vr.l6074)

[Link to publication record in Explore Bristol Research](#)  
PDF-document

This is the author accepted manuscript (AAM). The final published version (version of record) is available online via BMJ Publishing Group at <https://veterinaryrecord.bmj.com/content/185/15/470> . Please refer to any applicable terms of use of the publisher.

## University of Bristol - Explore Bristol Research

### General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:  
<http://www.bristol.ac.uk/red/research-policy/pure/user-guides/ebr-terms/>

**Small animal disease surveillance 2019: Pruritus, pharmacosurveillance, skin tumours and flea infestation**

David A. Singleton <sup>a,\*</sup>, John McGarry <sup>b</sup>, Jose Rodríguez Torres <sup>c</sup>, David Killick <sup>b</sup>, Christopher Jewell <sup>d</sup>, Steven Smyth <sup>a</sup>, Bethaney Brant <sup>a</sup>, Fernando Sánchez-Vizcaíno <sup>e</sup>, Susan Dawson <sup>b</sup>, Gina L. Pinchbeck <sup>a</sup>, Peter J.M. Noble <sup>b</sup>, Alan D. Radford <sup>a</sup>

<sup>a</sup> *Institute of Infection and Global Health, University of Liverpool, Leahurst Campus, Chester High Road, Neston, CH64 7TE, United Kingdom*

<sup>b</sup> *Institute of Veterinary Science, University of Liverpool, Leahurst Campus, Chester High Road, Neston, CH64 7TE, United Kingdom*

<sup>c</sup> *Institute of Animal Health and Food Safety, University of Las Palmas de Gran Canaria, Campus Universitario Cardones de Arucas, 35413 Arucas, Las Palmas, Spain*

<sup>d</sup> *Lancaster Medical School, Lancaster University, Furness Building, Lancaster, LA1 4YG, United Kingdom*

<sup>e</sup> *Bristol Veterinary School, University of Bristol, Langford Campus, BS40 5DU, United Kingdom*

\* Corresponding author. Tel: +44 151 7956080

E-mail address: [D.A.Singleton@liverpool.ac.uk](mailto:D.A.Singleton@liverpool.ac.uk) (D.A. Singleton)

## Report summary

- Presentation for investigation and/or treatment of pruritus represented 4.7 per cent, 2.2 per cent and 0.9 per cent of total dog, cat and rabbit consultations respectively between 1 May 2018 and 30 June 2019.
- Cytology was the most frequently recorded diagnostic test for both dogs (9.5 per cent of pruritus survey responses) and cats (4.1 per cent).
- The proportion of pruritus consultations which prescribed antibiotics authorised for systemic administration (including oral and injectable formulations) decreased between April 2014 and June 2019 by approximately 50 per cent and 33 per cent in dogs and cats, respectively.
- In a new multi-diagnostic laboratory tumour registry curated by SAVSNET, skin tumours (including cutaneous and subcutaneous origins) were commonly reported, with the most commonly reported malignant skin tumours being mast cell tumours in dogs (14.6 per cent of total pathological diagnoses), and squamous cell carcinomas in cats (7.4 per cent).
- In a clinical narrative summary of records of flea infestation between October 2014 and April 2019 a clear autumnal peak in flea infestation frequency was noted in both dogs and cats, although evidence of flea infestation was observed throughout the year.

## About this report

This report is the ninth in a series by the Small Animal Veterinary Surveillance Network (SAVSNET). The other reports in the series are available from: <http://veterinaryrecord.bmj.com>. As data are collected for longer periods, the estimates of changes in disease burden will become more refined, allowing more targeted local and perhaps national interventions. Anonymised data can be accessed for research by contacting the authors. SAVSNET also welcomes feedback on this report. More information about SAVSNET is available at <http://www.liverpool.ac.uk/savsnet>.

## **Syndromic surveillance of pruritus**

This is the third summary report on pruritus in companion animals collated by the Small Animal Veterinary Surveillance Network (SAVSNET) (Arsevska and others 2018; Sanchez-Vizcaino and others 2016). The present report considers electronic health records (EHRs) captured by the SAVSNET project from 217 voluntary veterinary practices (482 sites) over a 14-month period from 1 May 2018 to 30 June 2019. A detailed description of the methodology used by SAVSNET to capture EHRs has been previously provided (Sánchez-Vizcaíno and others 2015; Sanchez-Vizcaino and others 2017). A total of 1,823,164 consultations were analysed, of which 70.6 per cent were from dogs, 26.2 per cent were from cats, 1.8 per cent were from rabbits, and the remaining 1.4 per cent were from other species, or where species was not recorded. Animals mainly presenting for investigation and/or treatment of pruritus according to the attending veterinary surgeon or nurse comprised 4.7 per cent, 2.2 per cent and 0.9 per cent of total dog, cat and rabbit consultations respectively.

Short questionnaires (Sanchez-Vizcaino and others 2016) were completed by the attending practitioner after 15,045 random pruritus consultations (12,673 canine, 2,184 feline, 13,652 unique animals). Of these dogs, 37.3 per cent were being presented with a new pruritic condition, whereas 60.5 per cent were presenting with a continuation of a pruritic condition. Of these cats, 43.8 per cent were being presented with a new pruritic condition, whereas 53.8 per cent were presenting with a continuation of a pruritic condition. However, duration of clinical signs of less than one month was the most common survey response for both dogs (50.3 per cent) and cats (50.2 per cent). As in previous reports, ears were the most commonly affected anatomical location in dogs, whereas the dorsal body was most commonly affected in cats (Table 1). Diagnostic testing was planned in 23.5 per cent of canine and 23.6 feline cases, with cytology being the most common in both dogs (9.5 per cent) and cats (4.1 per cent). These findings were broadly consistent with SAVSNET's previous reports (Arsevska and others 2018; Sanchez-Vizcaino and others 2016).

## **Spatial distribution of pruritus**

The spatial distribution of the relative risk for pruritus was evaluated in dogs and cats in England, Scotland and Wales for each season of the surveillance period between 1 May 2018 and 30 June 2019. For consultations with a valid owner postcode the central point ('centroid') of each postcode was used to indicate the approximate residence of each recorded animal. Hence, these centroids were aggregated into 20km gridded cells, calculating the proportion of

total consultations mainly presenting with pruritus. Standard error (SE) for each cell was calculated to provide a measure of relative confidence in findings due to variable geographic consultation coverage, with these values being used to formulate septile bi-variate maps, where the darkest red colours indicate highest proportions of pruritus (greater than 8.7 per cent and 4.2 per cent for dogs and cats respectively) and lowest standard errors (Figure 1). As previously observed (Arsevska and others 2018; Sanchez-Vizcaino and others 2016), transient regions of increased pruritus incidence were distributed seemingly randomly throughout the country and in most seasons. In future, SAVSNET will need to work with others to develop robust statistical and practical methods to determine whether these transient increases in pruritus prevalence represent localised infectious disease outbreaks.

### **Pruritus pharmacosurveillance**

For the first time in these reports we also analysed pharmaceutical prescriptions given during pruritus consultations recorded between 1 April 2014 and 30 June 2019 in dogs ( $n = 219,654$  pruritus consultations), cats ( $n = 43,386$ ) and rabbits ( $n = 1,299$ ). A semi-automated text mining methodology was utilised to identify the active substance(s) dispensed in each consultation using the 'product dispensed' field of the EHR; these active substances were summarised into a hierarchical pharmaceutical classification system as previously described (Singleton and others 2018; Singleton and others 2017). For the purposes of this report, five pharmaceutical families of particular relevance to pruritic skin disease were analysed, including antibiotics authorised for systemic (oral or injectable) or topical (ocular, aural, skin) use; anti-inflammatories authorised for systemic or topical use; antimycotics; endectocides or ectoparasitocides, and euthanasia.

For dogs, systemic antibiotics were prescribed in 20.8 per cent of pruritus consultations; topical antibiotics in 31.8 per cent; systemic anti-inflammatories in 37.2 per cent; topical anti-inflammatories in 27.8 per cent; antimycotics in 22.0 per cent, and endectocides or ectoparasitocides in 10.1 per cent. For cats, systemic antibiotics were prescribed in 23.5 per cent of pruritus consultations; topical antibiotics in 11.6 per cent; systemic anti-inflammatories in 60.0 per cent; topical anti-inflammatories in 10.7 per cent; antimycotics in 5.6 per cent, and endectocides or ectoparasitocides in 28.1 per cent. For rabbits, systemic antibiotics were prescribed in 9.0 per cent of pruritus consultations; topical antibiotics in 13.8 per cent; systemic anti-inflammatories in 6.6 per cent; topical anti-inflammatories in 9.4 per cent; antimycotics in 5.8 per cent, and endectocides or ectoparasitocides in 59.2 per cent. Dogs were euthanised in

0.02 per cent of pruritus consultations, compared to 0.07 per cent of cat and 0.3 per cent of rabbit pruritus consultations.

Temporal trends in prescription frequency were also examined in dogs and cats (Figure 2). Over the five years analysed, an approximately 50 per cent and 33 per cent decrease in the frequency with which systemic antibiotics were prescribed in dogs and cats respectively was noted in this population. Evidence of seasonal prescription variation was observed for endectocide / ectoparasiticide and systemic anti-inflammatory prescription, peaking in the 3<sup>rd</sup> or 4<sup>th</sup> quarter of each year. This trend was particularly apparent for cats, suggesting a relationship between presumed parasite infestation and inflammatory responses to such infestations, though this requires verification. Some pharmaceutical families were very closely temporally matched (e.g. feline topical antibiotic and topical anti-inflammatory prescription), likely reflecting prescription of multivalent topical products.

#### **Update on main presenting complaint temporal trends in companion animals**

An observed prevalence time series for three key main presenting complaints (pruritus, gastroenteric and respiratory) from June 2017 to June 2019 is shown in Figure 3, together with a seasonal trend line (dark grey line). The trend line was calculated using a Bayesian binomial generalised linear model trained on weekly prevalence between 2014 and 2019, as fully described previously (Arsevska and others 2018). Extreme prevalence observations describing weekly prevalence exceeding 99 per cent credible intervals, and moderate prevalence observations describing weekly prevalence exceeding 95 per cent credible intervals are displayed in red and orange respectively.

These results show continued seasonal prevalence fluctuations in both species, particularly apparent for pruritus in both dogs and cats, and respiratory disease in dogs. In dogs and cats, there have been a number of instances of extreme increases in 2019, most notably for respiratory cases: It is currently unknown whether these findings represent a true increase in disease prevalence, or reflect the changing nature of participation in the SAVSNET project.

#### **Laboratory data: Histological and cytological reports of skin tumours in companion animals**

A total of 109,930 canine and feline tumour reports, confirmed via histological (63.9 per cent of tumour reports) and / or cytological (36.1 per cent) examination, were collated into a new

pet tumour registry curated by SAVSNET. These data originate from pathology reports supplied by three participating diagnostic laboratories between April 2018 and June 2019. Of total tumour reports, 91.5 per cent were of canine origin, and 8.5 per cent of feline origin.

In dogs, skin tumours (including both cutaneous and / or subcutaneous) accounted for a large majority (72.7 per cent) of total tumour reports, whereas approximately half of feline tumours (54.9 per cent) were skin-based. Figure 4 shows the most frequently diagnosed skin tumours in dogs and cats as a percentage of total tumour reports, revealing the most commonly reported malignant skin tumours as mast cell tumours in dogs (14.6 per cent of total tumours), and squamous cell carcinomas in cats (7.4 per cent). In our report feline lipoma reports were almost double that of an earlier study (Ho and others 2018), warranting further investigation.

Table 2 shows the proportions of common dog breeds attending veterinary practices, as recorded by SAVSNET between 2018 and 2019, with the percentage of such breeds affected by the five most commonly reported skin tumours identified in this newly formed tumour registry. We found Labrador retrievers to be more frequently associated with a lipoma report than their relative veterinary practice attendance frequency would suggest; a finding in line with a previous study (O'Neill and others 2018). We similarly noted that French bulldogs were over-represented in relation to histiocytoma reports. Histiocytomas tend to predominantly affect dogs less than four years of age (Taylor and others 1969). Considering that 90.7 per cent ( $n = 9,272$  total dogs) of recorded veterinary practice-attending French bulldogs were born from 2015 onwards, we speculate that a relatively younger breed population might be responsible for the findings observed here. Finally, a preponderance of boxer dogs to suffer from a variety of tumours is well known in the veterinary profession (Cohen and others 1974; Gruntzig and others 2016), and indeed this is a finding further corroborated in our current report. The new SAVSNET tumour registry will provide more information related to tumours in companion animals in upcoming reports.

#### **Update on fleas of cats and dogs**

Despite increased research and development of control products over several decades (Halos and others 2014), domestic fleas - the most important ectoparasite of dogs and cats worldwide – continue to torment companion animals and to infest homes. The most recent practice-level survey in the UK (Abdullah and others 2019) has shown that some 28.1 per cent of cats and 14.4 per cent of dogs are infested in early summer, and predictably that some 90 per cent of

recovered fleas - from both cats and dogs – are the cat flea *Ctenocephalides felis felis*. Other studies in the past 10 years have confirmed high rates of infestations of 12-47 per cent in some European countries. Cat flea populations vary considerably from year to year, but with a consistent tendency to increase from spring to autumn. The flea life cycle is ‘nest-adapted’, unique in being able to survive low temperatures and situations where their host comes and goes; not only can the cat flea be found in houses in the colder months of the year, they may still be present in premises that have been left unoccupied for several months.

In this report, we have provided a simple summary of clinical narrative mentions of ‘fleas’ or ‘flea dirt’ between 1 October 2014 and 30 April 2019 in Figure 5. A 10-day moving average of flea mentions per 1,000 canine or feline consultations respectively has been employed, excluding any days where less than 1,000 total consultations were collected by SAVSNET in each respective species. It can be seen that flea prevalence has a clear seasonal pattern, that fleas can be found on dogs or cats in any month of the year, and that fleas are more frequently recorded in EHRs for cats than dogs.

Besides direct skin damage caused by frequent blood feeding, fleas can cause a flea allergic dermatitis (FAD) in susceptible cats and dogs, and also serve as an intermediate host for the tapeworm *Dipylidium caninum*. But perhaps less well known is the animal flea’s potential worldwide to transmit pathogens – for example *Yersinia pestis* (plague), *Rickettsia typhi* (murine typhus), *R. felis* (flea spotted fever), *Bartonella henselae* (cat scratch fever), and in rabbits myxomatosis. In the UK, Abdullah and others (2019) recently demonstrated that 14 per cent of pet fleas carry at least one pathogen and approximately 11 per cent were positive for *Bartonella* spp., which is also of public health concern.

### **Clinical signs**

The vast majority of pets suffer from irritation and pruritus; they continuously scratch, groom, lick or vigorously nibble at the coat. Some cats are able to withstand infestation by hundreds of parasites and only express mild pruritus, whereas others present with allergic dermatitis with only a few fleas. Other clinical signs are more specific to cats, such as military dermatitis, which is defined by numerous papules and small scabs on the back and around the neck. Self-inflicted injuries are also possible and hair loss can be seen on the abdominal area, legs, flanks or tail as a result. In heavy infestations, animals may be anaemic.



## 215 **Diagnosis**

216 Definitive diagnosis relies on finding fleas in the coat, focussing on the tail, ventral face and  
217 neck areas in particular. Evidence of flea presence by finding flea faeces however is somewhat  
218 easier than seeing the fleas themselves: ‘flea dirt’ appears as small semi circles of shiny black  
219 grit up to 1 mm in length, and when placed on dampened blotting paper, colour the paper red  
220 due to the blood-rich diet of fleas. A diagnostic suspicion may be helped by questioning the pet  
221 owner: it is not unusual for family members in the affected household to complain about insect  
222 bites, which often appear in a series of marks on the legs and ankles. It should be remembered  
223 that fleas other than cat and dog fleas may cause problems. Those associated with rodents, birds  
224 and hedgehogs may be found on pets and bite people, complicating control programmes.

## 226 **Treatment and control**

227 Details on integrated flea control programmes are available elsewhere:  
228 <https://www.esccap.org/guidelines>. Eradication of fleas from pets and households remains a  
229 challenge but is achievable, over a timescale of several months, if basic rules and treatment  
230 intervals are respected. Briefly, in cases of existing infestations, a combination of  
231 methodologies is often recommended. Alongside application to the environment of a flea  
232 adulticide and concurrent use of an insect growth regulator to break the flea life cycle, regular  
233 mechanical hoovering to remove flea immature environmental stages is needed, especially in  
234 and around areas where animals sleep. Washing affected pet bedding at temperatures greater  
235 than 60°C is also recommended. However, every situation requires a full ‘flea risk’ assessment,  
236 a bespoke plan which addresses the threat of re-infestation, by a thorough analysis of the  
237 behavioural life styles and movements of all in contact animals. Control breakdowns do occur,  
238 sometimes linked to disregard of re-treatment intervals following perceived poor outcomes. As  
239 such, time taken by the veterinary professional to explain the enduring nature of the flea life  
240 cycle and in managing client expectations will always be time well invested.

242 There is now a plethora of flea adulticides on the animal health market, but two agents in  
243 particular - imidacloprid and fipronil - were perceived as the holy grail when first introduced in  
244 the early 1980s, being formulated as convenient monthly spot-on applications, and replacing to  
245 a large extent the poorly targeted and neurotoxic organophosphates then in widespread use.  
246 Killing fleas as quickly as possible is highly desirable, and the introduction in the past few years  
247 of the potent fast-acting systemic isoxazolines (fluralaner, afoxolaner, sarolaner and lotilaner)  
248 marks the latest advance in integrated control for ectoparasites of dogs and cats. This

pharmaceutical class is very effective against fleas, as well as ticks, and trials are showing high efficacy against a range of other common mange mites and ectoparasites. Although they do not prevent biting, cat fleas are killed in a matter of hours following a blood meal from a treated animal. In the case of fluralaner, which is also formulated for topical use, therapeutic levels are maintained for up to 3 months (thereby reducing owner compliance issues). In addition, an enduring potent impact at sub-lethal levels on flea reproduction has been demonstrated experimentally (Williams and others 2014), with the high potential therefore to break the natural flea life cycle in the domestic setting.

## **Horizon scanning**

### **Tuberculosis in cats**

We recently saw the publication of an outbreak of *Mycobacterium bovis* in six clinically sick cats (five of which died or were euthanased) and seven in-contact cats across England. Affected cats frequently presented with weight loss, lethargy, anorexia, respiratory signs and palpable abdominal masses / lymphadenopathy: some showed gastrointestinal signs creating the potential for even greater exposure to owners (O'Halloran and others 2019). Two owners also had immunological evidence of tuberculosis infection.

All affected cats lived exclusively indoors. Frequent causes of tuberculosis infection were excluded including wildlife / rodent contact, raw milk and exposure to known infectious humans. However, there was strong evidence of an association with a particular commercial raw pet food. According to its manufacturer (Nature Valley), they no longer manufacture and sell the particular venison-based product implicated. The Edinburgh research team behind the research state that new cases are still occurring. Animals known to have been exposed to the recalled food, or which have been exposed to a confirmed case but are displaying no clinical signs, should be tested by interferon assay at least four weeks after the last known exposure. This detailed piece of research highlights the potential for tuberculosis in cats even in areas where bovine tuberculosis is not endemic. Although risk to in-contact humans is considered low, people clearly can contract tuberculosis from infected cats (PHE 2014).

### **Myxomatosis**

Myxomatosis is caused by a poxvirus transmitted by biting parasites between rabbits. Using data derived from SAVNSET veterinary practices we have confirmed that August – November is the peak season for this disease. The disease is best controlled by vaccination.

283

284 **Acknowledgements**

285 SAVSNET is based at the University of Liverpool and currently funded by the Biotechnology  
286 and Biological Sciences Research Council. We are indebted to the British Small Animal  
287 Veterinary Association for their support. The SAVSNET team is grateful to the veterinary  
288 practices and diagnostic laboratories that provide health data and without whose support these  
289 reports would not be possible. It wishes to thank Abbey Veterinary Services, Axiom Veterinary  
290 Laboratories Ltd, Batt Laboratories, BioBest, CAPL, CVS, Idexx, Lab Services Ltd, Langford  
291 Veterinary Services, NationWide Laboratory Services, SRUC, Teleos, Test A Pet,  
292 Microbiology Diagnostics Laboratory at University of Liverpool, VPG Exeter, VPG Ringwood,  
293 VPG Leeds and VPG Hitchin and Vet Solutions (the suppliers of RoboVet and PremVet). The  
294 team would also like to thank Susan Bolan, SAVSNET project administrator, for her help and  
295 support.

## Tables

Table 1: Canine ( $n=12,673$ ) and feline ( $n=2,184$ ) anatomical sites affected by pruritus in randomly selected consultations between 1 May 2018 and 30 June 2019.\*

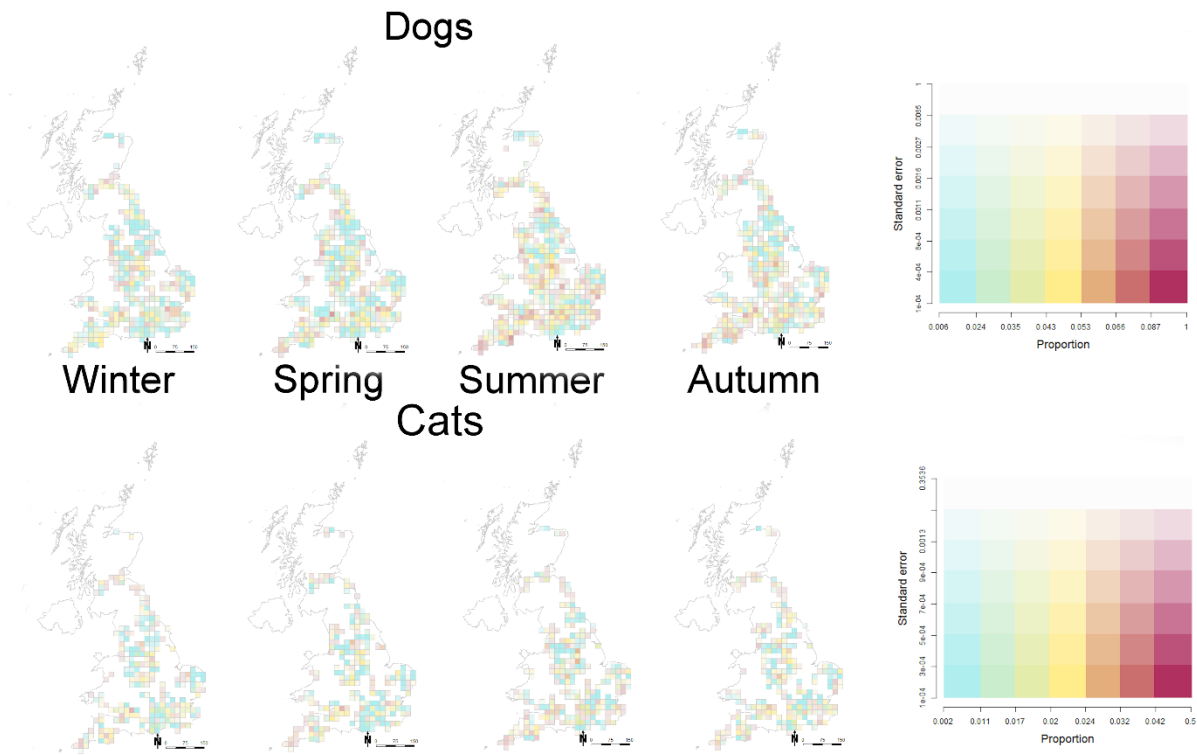
Anatomical site	Number (%) of dogs	Number (%) of cats
Dorsal body	1,993 (15.7)	894 (40.9)
Ears	6,300 (49.7)	560 (25.6)
Face	1,789 (14.1)	670 (30.7)
Feet / limbs	3,538 (27.9)	339 (15.5)
Tail-head / perineum	1,782 (14.1)	405 (18.5)
Ventral body	3,112 (24.6)	611 (28.0)
Other site	957 (7.6)	209 (9.6)

\* The same animal could present with more than one affected anatomical site per consultation

Table 2: Comparison of percentage of common dog breeds visiting SAVSNET-participating veterinary practices, as a proportion of total recorded dog consultations with percentage of histological / cytological skin tumour reports as collated by SAVSNET from three veterinary diagnostic laboratories, between April 2018 and June 2019.

\*NOS refers to 'not otherwise specified' whereby a specific tumour designation was not provided by the examining pathologist, but instead a general term e.g. carcinoma was used. Such occurrences most commonly referred to cytological examinations.

Breed	Veterinary-visiting breed percentage (%)	Percentage (%) of histological / cytological tumour reports				
		Lipoma	Mast cell tumour	Histiocytoma	Soft tissue sarcoma	Neoplasia (NOS*)
Labrador Retriever	8.4	18.4	16.1	7.1	9.0	14.6
Crossbreed	21.2	17.2	12.0	14.3	19.2	14.6
Cocker Spaniel	5.2	6.6	0.9	5.7	2.9	4.4
Staffordshire Bull Terrier	3.6	5.1	17.4	5.7	7.6	6.6
English Springer Spaniel	3.1	4.4	1.6	2.6	4.1	3.8
Boxer	0.9	0.8	7.4	4.4	3.6	3.1
Pug	1.2	0.1	4.8	2.4	0.1	1.1
French Bulldog	1.7	0.04	1.1	5.7	0.1	0.9
Jack Russell Terrier	5.1	3.2	3.6	2.6	4.3	3.0



309  
310 **Figure 1:** Septile bi-variate maps indicating proportion of total canine and feline consultations  
311 (1 May 2018 – 30 Jun 2019) presenting mainly for investigation and/or treatment of pruritus,  
312 summarised by 20km gridded cells encompassing England, Scotland and Wales. Proportion has  
313 been modelled against standard error to provide a measure of relative confidence in findings  
314 according to the volume of data collected in each cell. Darker red colours indicate areas of  
315 relatively high confidence and prevalence.

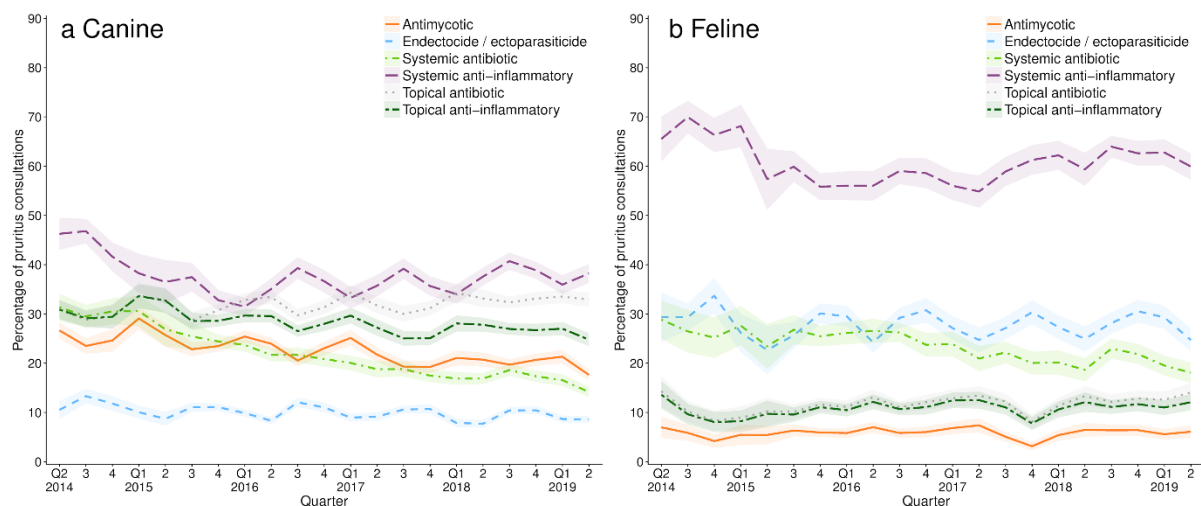


Figure 2: Percentage of canine and feline pruritus consultations where systemic antibiotics; topical antibiotics; systemic anti-inflammatories; topical anti-inflammatories; endectocides / ectoparasitides, or antimycotics were prescribed, by quarter (Q2 2014 – Q2 2019). Shaded regions refer to 95% confidence intervals, calculated to adjust for clustering within veterinary practice site (bootstrapped estimated,  $n$  replicates = 5,000).

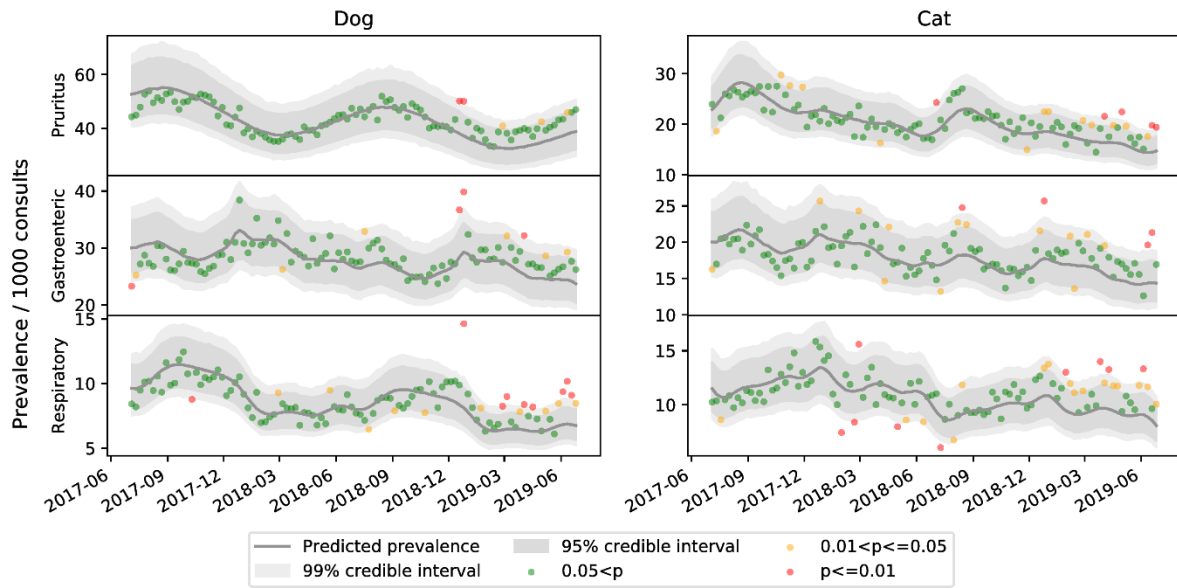
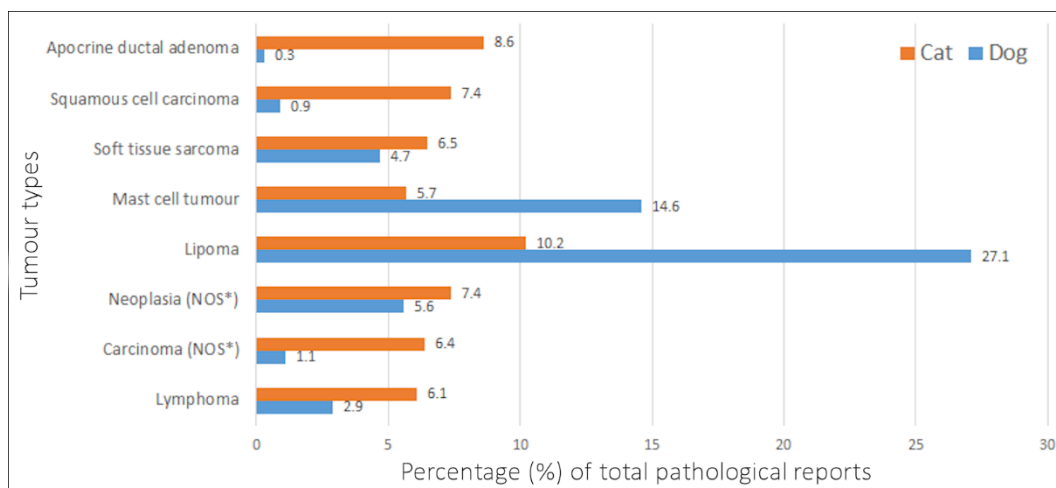


Figure 3: Observed prevalence per 1,000 consultations for pruritus, gastroenteritis and respiratory disease in cats and dogs attending SAVSNET-participating practices from June 2017 to June 2019. Red points represent the extreme outliers (outside the 99 per cent credible interval [CI]), orange points represent the moderate outliers (outside the 95 per cent CI but within the 99 per cent CI), and green points represent the average trend (within the 95 per cent CI).

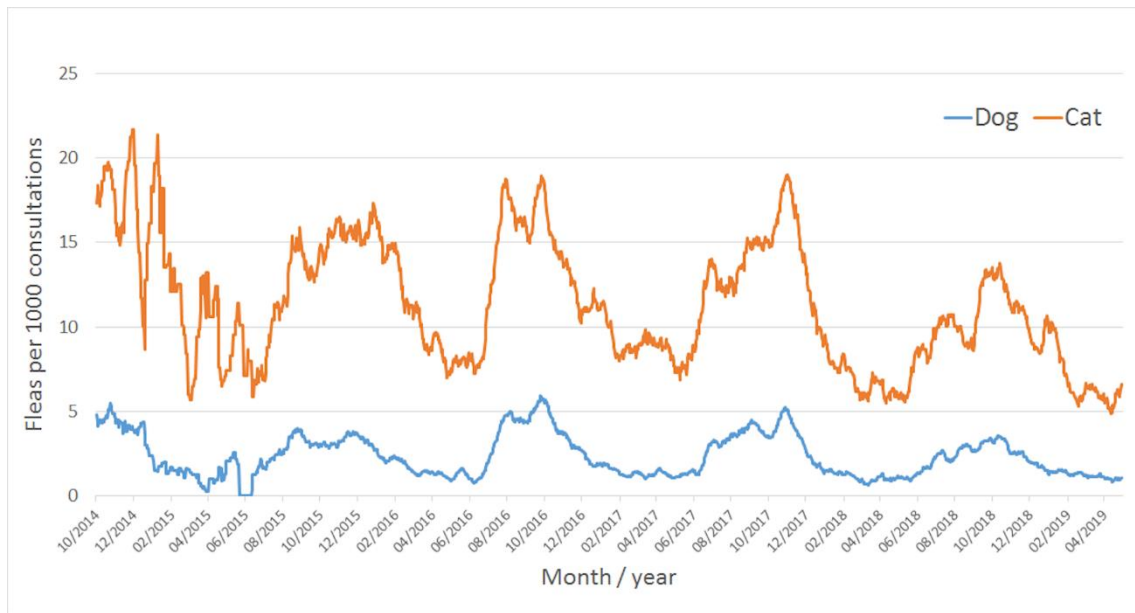


332



333

334 Figure 4: Most frequently reported skin tumours in dogs and cats, as a percentage of total  
335 tumour reports in each species.\*NOS refers to 'not otherwise specified' whereby a specific  
336 tumour designation was not indicated by the examining pathologist, but instead a general  
337 term e.g. carcinoma was used; such occurrences most frequent in cytological examinations.  
338



339

340 Figure 5: Flea infestation records per 1,000 dog and cat consultations expressed as a 10-day  
341 rolling average, as recorded within the free text clinical narrative as collected by SAVSNET  
342 between October 2014 and April 2019. Days collecting less than 1,000 total consultations  
343 were excluded from the analyses.

## References

- ABDULLAH, S., HELPS, C., TASKER, S., NEWBURY, H. & WALL, R. (2019) Pathogens in fleas collected from cats and dogs: distribution and prevalence in the UK. *Parasit Vectors* 12, 71
- ARSEVSKA, E., SINGLETON, D. A., JEWELL, C., PATERSON, S., JONES, P. H., SMYTH, S., BRANT, B., DAWSON, S., NOBLE, P. J. M., SANCHEZ-VIZCAINO, F. & RADFORD, A. D. (2018) Small animal disease surveillance: pruritus and *Pseudomonas* skin infections. *Vet Rec* 183, 182-187
- COHEN, D., REIF, J. S., BRODEY, R. S. & KEISER, H. (1974) Epidemiological analysis of the most prevalent sites and types of canine neoplasia observed in a veterinary hospital. *Cancer Res* 34, 2859-2868
- GRUNTZIG, K., GRAF, R., BOO, G., GUSCETTI, F., HASSIG, M., AXHAUSEN, K. W., FABRIKANT, S., WELLE, M., MEIER, D., FOLKERS, G. & POSPISCHIL, A. (2016) Swiss Canine Cancer Registry 1955-2008: Occurrence of the Most Common Tumour Diagnoses and Influence of Age, Breed, Body Size, Sex and Neutering Status on Tumour Development. *J Comp Pathol* 155, 156-170
- HALOS, L., BEUGNET, F., CARDOSO, L., FARKAS, R., FRANC, M., GUILLOT, J., PFISTER, K. & WALL, R. (2014) Flea control failure? Myths and realities. *Trends in Parasitology* 30, 228-233
- HO, N. T., SMITH, K. C. & DOBROMYLSKYJ, M. J. (2018) Retrospective study of more than 9000 feline cutaneous tumours in the UK: 2006-2013. *J Feline Med Surg* 20, 128-134
- O'HALLORAN, C., IOANNIDI, O., REED, N., MURTAGH, K., DETTEMERING, E., VAN POUCKE, S., GALE, J., VICKERS, J., BURR, P., GASCOYNE-BINZI, D., HOWE, R., DOBROMYLSKYJ, M., MITCHELL, J., HOPE, J. & GUNN-MOORE, D. (2019) Tuberculosis due to *Mycobacterium bovis* in pet cats associated with feeding a commercial raw food diet. *J Feline Med Surg* 21, 667-681
- O'NEILL, D. G., CORAH, C. H., CHURCH, D. B., BRODBELT, D. C. & RUTHERFORD, L. (2018) Lipoma in dogs under primary veterinary care in the UK: prevalence and breed associations. *Canine Genet Epidemiol* 5, 9
- PHE (2014) Cases of TB in domestic cats and cat-to-human transmission: risk to public very low. <https://www.gov.uk/government/news/cases-of-tb-in-domestic-cats-and-cat-to-human-transmission-risk-to-public-very-low>Access, 2014
- SÁNCHEZ-VIZCAÍNO, F., JONES, P. H., MENACERE, T., HEAYNS, B., WARDEH, M., NEWMAN, J., RADFORD, A. D., DAWSON, S., GASKELL, R., NOBLE, P. J. M., EVERITT, S., DAY, M. J. & MCCONNELL, K. (2015) Small animal disease surveillance. *Veterinary Record* 177, 591-594
- SANCHEZ-VIZCAINO, F., NOBLE, P. M., JONES, P. H., MENACERE, T., BUCHAN, I., REYNOLDS, S., DAWSON, S., GASKELL, R. M., EVERITT, S. & RADFORD, A. D. (2017) Demographics of dogs, cats, and rabbits attending veterinary practices in Great Britain as recorded in their electronic health records. *BMC Vet Res* 13, 218
- SANCHEZ-VIZCAINO, F., SINGLETON, D., JONES, P. H., HEAYNS, B., WARDEH, M., RADFORD, A. D., SCHMIDT, V., DAWSON, S., NOBLE, P. J. & EVERITT, S. (2016) Small animal disease surveillance: pruritus, and coagulase-positive staphylococci. *Vet Rec* 179, 352-355
- SINGLETON, D. A., SANCHEZ-VIZCAINO, F., ARSEVSKA, E., DAWSON, S., JONES, P. H., NOBLE, P. J. M., PINCHBECK, G. L., WILLIAMS, N. J. & RADFORD, A. D. (2018) New approaches to pharmacosurveillance for monitoring prescription frequency, diversity, and co-prescription in a large sentinel network of companion animal veterinary practices in the United Kingdom, 2014-2016. *Prev Vet Med* 159, 153-161
- SINGLETON, D. A., SANCHEZ-VIZCAINO, F., DAWSON, S., JONES, P. H., NOBLE, P. J. M., PINCHBECK, G. L., WILLIAMS, N. J. & RADFORD, A. D. (2017) Patterns of antimicrobial agent prescription in a sentinel population of canine and feline veterinary practices in the United Kingdom. *Vet J* 224, 18-24
- TAYLOR, D. O., DORN, C. R. & LUIS, O. H. (1969) Morphologic and biologic characteristics of the canine cutaneous histiocytoma. *Cancer Res* 29, 83-92
- WILLIAMS, H., YOUNG, D. R., QURESHI, T., ZOLLER, H. & HECKEROTH, A. R. (2014) Fluralaner, a novel isoxazoline, prevents flea (*Ctenocephalides felis*) reproduction in vitro and in a simulated home environment. *Parasit Vectors* 7, 275